CLAIMS

1. A hydrogen reforming system, comprising:

a cyclical compression chamber having an entry port for receiving hydrogen-containing gas and an exit port for delivering reformed hydrogen-containing gas, the cyclical compression chamber having an operational cycle with an internal pressure and temperature absent combustion effective for reforming the hydrogen-containing gas;

a heating system for heating the hydrogen-containing gas to a non-combustible temperature; and

a drive system for cycling the cyclical compression chamber.

2. The system of Claim 1, wherein the heating system comprises:

a source of steam; and

a second entry port at the cyclical compression chamber for receiving the steam, the second entry port having an open state in response to the volume of the cyclical compression chamber increasing, thereby providing an injection of steam for increasing the temperature of the hydrogen-containing gas to a non-combustible temperature as the volume of the cyclical compression chamber increases for prolonging reformation chemistry.

3. The system of Claim 2, further wherein:

the second entry port having an open state in response to the volume of the cyclical compression chamber decreasing, thereby providing an injection of steam for increasing the temperature of the hydrogen-containing gas to a non-combustible temperature as the volume of the cyclical compression chamber decreases for promoting the initiation of reformation chemistry.

4. The system of Claim 1, wherein the drive system comprises:

a power-plant including a combustion engine, an electric-powered motor, a wind-powered motor, a solar-powered motor, or a hydro-powered motor; and

a drive shaft responsive to the power-plant and in operable communication with the cyclical compression chamber.

5. The system of Claim 1, further comprising:

a gas separator having an entry port for receiving the reformed hydrogen-containing gas, a first exit port for delivering reformed hydrogen separated from the reformed hydrogen-containing gas, and a second exit port for delivering gas separator byproducts.

6. The system of Claim 5, wherein the gas separator comprises a membrane penetrable by hydrogen gas and non-penetrable by methane, carbon-monoxide, carbon-dioxide, or water.

7. The system of Claim 5, wherein the gas separator comprises:

an entry valve and an exit valve, each in fluid communication with the cyclical compression chamber, arranged for pressurizing and depressurizing the reformed hydrogen-containing gas in the gas separator in response to a change in pressure at the cyclical compression chamber to produce pressurized reformed hydrogen-containing gas;

wherein the pressurized reformed hydrogen-containing gas is separated in the gas separator into hydrogen gas and byproducts.

8. The system of Claim 5, further comprising:

a heat transfer device for transferring heat from the gas separator byproducts to the means for heating the hydrogen-containing gas, thereby utilizing system-generated energy for heating the hydrogen-containing gas to a non-combustible temperature.

9. The system of Claim 1, wherein:

the effective temperature internal of the cyclical compression chamber is equal to or greater than 650 degrees Celsius and equal to or less than 900 degrees Celsius; and

the effective pressure internal of the cyclical compression chamber has a compression ratio of equal to or greater than 17.

10. A method for producing hydrogen by reforming hydrogen-containing gas, comprising:

introducing the hydrogen-containing gas into a cyclical compression chamber;

increasing the pressure and temperature of the hydrogen-containing gas by reducing the volume of the cyclical compression chamber to initiate reformation chemistry;

continuing the reformation chemistry in the cyclical compression chamber under conditions of pressure and temperature and in the absence of combustion effective to convert a portion of the hydrogen-containing gas into reformed hydrogen-containing gas;

quenching the reformation chemistry by increasing the volume of the cyclical compression chamber; and

discharging the reformed hydrogen-containing gas from the cyclical compression chamber.

11. The method of Claim 10, further comprising:

pre-heating the hydrogen-containing gas prior to introducing the hydrogen-containing gas into the cyclical compression chamber.

12. The method of Claim 10, further comprising:

separating the reformed hydrogen-containing gas into hydrogen gas and byproducts.

13. The method of Claim 12, wherein the separating the reformed hydrogen-containing gas comprises:

pressurizing and depressurizing the reformed hydrogen-containing gas in response to a change in pressure at the cyclical compression chamber to produce pressurized reformed hydrogen-containing gas; and

separating the pressurized reformed hydrogen-containing gas in a pressure-driven manner into hydrogen gas and byproducts.

14. The method of Claim 12, further comprising:

introducing auxiliary heat into the cyclical compression chamber to continue the reformation chemistry as the volume of the cyclical compression chamber increases, thereby furthering the degree of reformation prior to the quenching the reformation chemistry.

15. The method of Claim 14, further comprising:

introducing auxiliary heat into the cyclical compression chamber as the volume of the cyclical compression chamber decreases to promote the initiation of reformation chemistry.

16. The method of Claim 14, further comprising:

converting the byproducts of the separated reformed hydrogen-containing gas into thermal energy and exhaust products;

wherein the introducing auxiliary heat comprises introducing auxiliary heat acquired from the thermal energy.

17. The method of Claim 14, wherein the introducing auxiliary heat comprises introducing steam into the cyclical compression chamber.

18. The method of Claim 10, wherein the continuing the reformation chemistry in the cyclical compression chamber under conditions of pressure and temperature and in the absence of combustion effective to convert a portion of the hydrogen-containing gas into reformed hydrogen-containing gas comprises:

continuing the reformation chemistry at a temperature of equal to or greater than 650 degrees Celsius and equal to or less than 900 degrees Celsius; and

continuing the reformation chemistry at a pressure having a compression ratio of equal to or greater than 17.

19. The method of Claim 18, wherein the continuing the reformation chemistry further comprises:

continuing the reformation chemistry for a crank angle duration equal to or greater than 15 degrees.

20. A hydrogen gas produced by the method of Claim 12.

21. A hydrogen reforming system, comprising:

a cyclical compression chamber having an entry port for receiving hydrogen-containing gas and an exit port for delivering reformed hydrogen-containing gas, the cyclical compression chamber having an operational cycle with an internal pressure and temperature absent combustion effective for reforming the hydrogen-containing gas; and

an internal combustion engine coupled to the cyclical compression chamber for driving the cyclical compression chamber through a gas reforming cycle;

wherein heat generated by the internal combustion engine is transferred to the cyclical compression chamber for raising the temperature of the hydrogen-containing gas to a non-combustible temperature.

22. The system of Claim 21, further comprising:

a gas separator having an entry port for receiving the reformed hydrogen-containing gas, a first exit port for delivering reformed hydrogen separated from the reformed hydrogen-containing gas, and a second exit port for delivering gas separator byproducts.